ORIE 6330 Network Flows

Course Information

September 2, 2020

1 Instructor Information

Instructor:	Prof. David Williamson
Office:	236 Rhodes Hall
Office hours:	Tuesdays 11-12, Thursdays 3-4, and by appt.
Email:	`davidpwilliamson@cornell.edu`
Phone:	(607) 255-4883
Course web site:	`people.orie.cornell.edu/dpw/orie6330/`

2 Lectures

Lectures will be Monday/Wednesday 1:25-2:40PM in Olin 255.

3 Prerequisites

There is no formal prerequisite. In practice, I will be assuming some previous exposure either to algorithms or combinatorial optimization. I will also be using some basic knowledge of linear programming on occasion, but have a handout on the website covering the needed material. The ill-defined property of mathmematical maturity is also required. Please talk to me if you have questions about whether you have the necessary background.

4 Textbooks

The required text is one that I wrote based on the contents of this class: *Network Flow Algorithms*, published by Cambridge University Press. You can download a free PDF at `www.networkflowalgs.com/book.pdf`.

Some other possible reference texts are listed below, though I will not draw on any of them with any regularity.

5 Requirements

There will be 4-5 problem sets, handed out and collected on a biweekly basis.

There will also be a take-home final exam. I will allow students to substitute a final project in place of the take-home final should they so desire. The project can involve implementing algorithms given in class and comparing their performance on various types of graphs; another possibility would be writing a 10+ page survey of flow algorithms or problems not presented in class. If you are interested in this option, you must give me an initial proposal by the mid-October, and we must have reached agreement on the nature of the project by the beginning of November. More information will be forthcoming.

6 Collaboration

Cornell's Code of Academic Integrity can be found at `cuinfo.cornell.edu/aic.cfm`.

Your work on problem sets and exams should be your own. You may discuss approaches to problems with other students, but as a general guideline, such discussions may not involve taking notes. You must write up solutions on your own independently, and acknowledge anyone with whom you discussed the problem. If you use papers or books or other sources (e.g. material from the web) to help obtain your solution, you must cite those sources. You may not discuss exam problems with other students.

7 Bibliography

Here is a list of books and other materials in the area that I will be drawing on for the course.

- Ravindra K. Ahuja, Thomas L. Magnanti, James B. Orlin, *Network Flows: Theory, Algorithms, and Applications*, Prentice-Hall, 1993.
- William J. Cook, William H. Cunningham, William R. Pulleyblank, Alexander Schrijver, *Combinatorial Optimization*, John Wiley & Sons, 1998.
- Bernhard Korte, Jens Vygen, *Combinatorial Optimization: Theory and Algorithms*, Fifth Edition, Springer-Verlag, 2012.
- Eugene Lawler, *Combinatorial Optimization: Networks and Matroids*, Holt, Rinehart, and Winston, 1976 (Reprinted by Dover Publications, 2001).
- Christos H. Papadimitriou, Kenneth Steiglitz, *Combinatorial Optimization: Algorithms and Complexity*, Prentice-Hall, 1982 (Reprinted by Dover Publications, 1998).
- Alexander Schrijver, *Combinatorial Optimization: Polyhedra and Efficiency*, Springer-Verlag, 2003.

8 Schedule

Here is a rough schedule for the course, which is subject to change without notice. This may be a bit ambitious; we will probably cover less material than is listed here.

Sep	2, 7, 9	Overview. Maximum flows; minimum s-t cuts. Optimality conditions. Applications of max flow. Problem set 1 out.
Sept	14, 16	Polynomial-time augmenting path algorithms. The push/relabel algorithm for max flow.
Sept	21, 23	Finding global minimum cuts: Hao-Orlin, MA orderings. Problem set 1 due. Problem set 2 due.
Sept	28, 30	Finding global minimum cuts: MA orderings, contraction algorithm. Blocking flows and the Goldberg-Rao algorithm.
Oct	5, 7	Minimum-cost circulations: optimality conditions. Problem set 2 due. Problem set 3 out.
Oct	12	Minimum-cost circulations: Cycle cancelling algorithms, strong polynomiality.
Oct	14	Fall break.
Oct	19, 21	Minimum-cost circulations: successive approximation, network simplex. Problem set 3 due. Problem set 4 out.
Oct	26, 28	Generalized flow: optimality conditions. Generalized flow algorithms. Initial project proposal due.
Nov	2, 4	Multicommodity flow: Definitions, two-commodity flow. The Garg-Könemann algorithm. Problem set 4 due. Problem set 5 out.
Nov	9, 11	Multicommodity flow: the Awerbuch-Leighton algorithm.
Nov	16, 18, 23	Flows over time: Maximum dynamic flows. Quickest transhipment. Problem set 5 due.
Nov	26	Thanksgiving: No class. Transition to online teaching.
Nov	30	Advanced topic.
Dec	2	Advanced topic.
Dec	7	Advanced topic. Take-home exam (or project due).

Note that the schedule above assumes that we will be able to use the 'semi-finals' period for lectures. The official academic calendar has the last day of classes as December 16.